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Enhancing Wood Recycling from Bulky Waste Using Multi-Sensor Fusion with Terahertz Imaging

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Here we present the ASKIVIT project, targeting enhanced wood recycling from bulky waste via an automated sorting system using a multi-sensor approach. This study introduces a wood sorting demonstrator equipped with four complementary sensing systems: visual imaging, near-infrared hyperspectral imaging, active heat flow thermography, and terahertz (THz) imaging.

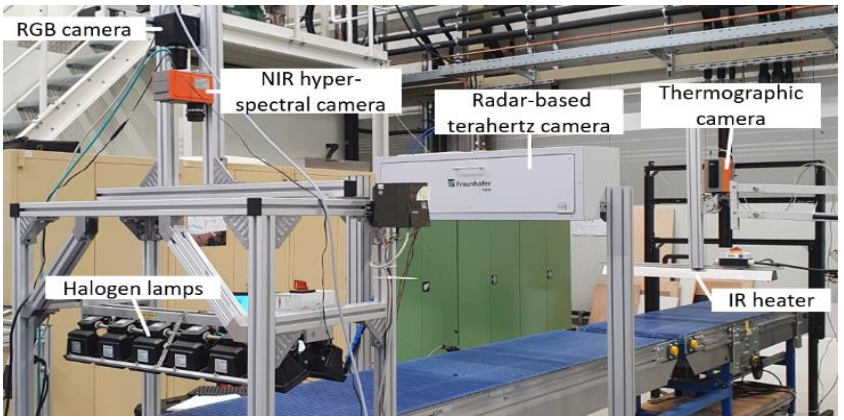

Fig. 1 Demonstrator for multi-spectral imaging. Presented in [1].

In the first experiment, a comprehensive demonstrator captured images of various bulky waste materials. The results highlight the advantages of each imaging modality, e.g., near-infrared hyperspectral imaging in characterizing different waste components and THz imaging in detecting metal beneath plastic or upholstery.

The second experiment focused on acquiring a multi-modal dataset to train and test a neural network for wood sorting. 57 multi-modal images were captured with samples moving at 10 cm/s on a conveyor belt. Early fusion results using only THz data achieved an accuracy of 0.77, whereas the best multi-modal data fusion accuracy reached 0.921. The THz system, operating in the W-band (75–110 GHz), employed a synthetic aperture radar design with 12 emitters and 12 receivers, enabling 3D imaging of complex structures. These experiments demonstrate the potential of multi-modal sensor fusion to improve the efficiency and accuracy of automated wood sorting from bulky waste, thereby advancing recycling efforts.

REFERENCES

[1] L. Roming, et. al, *Conference Proceedings:* OCM 2023 - Optical Characterization of Materials (2023) pp. 23-36.
[2] D. Čibiraitė-Lukenskienė et al., *Conference Proceedings:* IRMMW-THz 2023, Montreal, Canada, (2023) pp. 1-2.

* Former location where the work was conducted

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